THE APPROPRIATENESS OF THE THAI NAVAL ACADEMY CURRICULUM

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THESIS

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ABSTRACT

Two hundred and fifty Thai Naval Officers were surveyed to determine the appropriateness of the Thai Naval Academy curriculum. Seventy-seven responded. They were asked to rank the importance of subjects in the curriculum for two criteria: the naval profession, and intellectual development of the individual. The rankings were scaled using the "Ford Computer Program." A judge reliability check done by correlating the rankings of half the judges against the other half showed a high positive correlation (r = .908), indicating uniformity of judgments. The scaled "weights" of both criteria were then reduced to one dimension by orthogonal projection onto a straight line contained in the plane with the two criteria as their axes. The resulting "weights" were used as the criterion variable and compared with percent of instruction time per subject in the curriculum. The correlation coefficient (rho) between the ranks of the weights and the ranks of the instruction time was low (rho = .423), but significant. The difference in ranks were used as indicator of each subject's level of appropriateness. Many subjects were found to be inappropriate. Adjustments of instruction time or replacement of those subjects highly inappropriate was deemed advisable.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

A. THE MILITARY PROFESSION

The military service has the same general characteristics as the other professions; namely, a specialized body of knowledge acquired through advanced training and experience, a mutually defined and sustained set of standards, and a sense of group identity and corporateness (Janowitz 1960). In addition, the military profession has several characteristics not shared by such other professions as law, education, or medicine. It is, for example, bureaucratized, with a hierarchy of offices and a legally defined structure (Huntington 1957). It is a uniquely public profession marked by its members' commitment to unlimited service, extending to the risk of life itself. These characteristics have important implications for the education of military personnel.

The peculiar expertise of the military profession has been defined in various ways. Beside Harold Lasswell's familiar formulation of it as the "management of violence," there is Lieutenant General Sir John W. Hackett's (1962) similarly narrow but precise definition: "The ordered application of force in the resolution of a social problem." Colonel G.A. Lincoln has observed that General Hackett's term "force" should be interpreted broadly as "military resources," to include their deterrent and peacekeeping roles (Lincoln 1964). Blending these various formulations and interpreting them in the context of the likely national security environment of the 1970s and beyond, we can arrive at a working definition of the expertise which today's and tomorrow's military education system should be principally devoted to developing; namely, "the management and application of military resources in deterrent, peacekeeping, and combat roles in the context of rapid technological, social, and political change."

This definition of military expertise necessarily implies a broader set of roles for the military officer than has been traditionally expected of him. This set includes (a) helping to define the nature of the nation's security tasks, especially their politico-military dimension; (b) applying scientific and technological knowledge to military matters; and (c) training, supplying, deploying, and, if necessary, employing the fighting capability of military units in the changing politico-military and technological environments. Rather than focusing exclusively on the narrow aspects of this third and traditional role, the model of a modern military officer must not only master the broader dimensions of the third task but also develop a competence in one or both of the other roles. He must do so, that is, if he expects to rise in his profession, for the politico-military and scientific-technological dimensions of the security problems interact with the narrowly tactical-technical ones in such a complex and continuing way that, if the militaryman masters only the traditional role, he cannot deal with the modern profession's problems -- except at the simplest level.

The distinctive expertise of the military profession is, of course, generated and transmitted by means other than the military's educational system. In particular, the more narrow aspects of the military tasks are generally taught in on-the-job or technical school training. While "training" and "education" are not always sharply differentiated activities, it is generally useful to separate them. Thus, "training programs are those which develop specific skills and are non-oriented, while education programs tend to be more complex and their learning outcomes to be more general in nature" (Shelburne and Growes, 1965). Masland and Radway (1957) expand this basic distinction by noting that training emphasizes form, procedure, uniformity, and immediate utility, whereas education is directed to developing the student's judgment and intellectual growth and to prepare him for the long-range future.

In addition to developing professional expertise, the military educational system contributes to building the other characteristics already noted as defining the profession; namely, a common set of standards, a sense of group identity, and a special commitment. These indoctrination and socialization functions are, again, not exclusively the province of the educational system, nor even of the school system. Depending on the particular pattern of his assignments, the young officer may well learn more in military units than in school, about the professional code; in particular, his identification with service values and with his colleagues may grow more out of his experience in a battalion, squadron, ship, or staff unit than from his attendance at schools.

B. THAI NAVAL OFFICER EDUCATION

The Thai Navy, as her sister services -- the Army and the Air Force, categorizes her officers by their source of commission: Naval Academy as "Type A," from enlisted ranks as "Type B," and direct appointment of college graduates as "Type C." According to the organizational structure, the career patterns of the three categories are mutually exclusive, the "Type A" being unrestricted line or engineering and "Type B" and "Type C" being limited duties. The scope of this investigation is limited only to Naval Academy education; therefore, the "Naval Officer" referred to henceforth will only be of "Type A."

1. Precommissioning Education

The candidate has completed seven years of primary education, which is compulsory for all Thai nationals, three years of secondary education, two years of high school education at the Armed Forces Preparatory School, and five years undergraduate education at the Naval Academy. The education at the Armed Forces Preparatory School is compatible with that of the civilian high schools with the addition of military indoctrination and intensive

physical training. The Naval Academy offers three years of basic curriculum for all midshipmen. Two options are then offered for the remaining two years, general line or engineering. The Naval Academy's course outlines are listed in Appendix A. A midshipman may repeat each class only once and must therefore graduate within 10 years. Upon graduation he is commissioned as an Ensign.

2. Postcommissioning Education and Training

The newly-commissioned officer spends his first year training on-the-job on board ships of the fleet. During his tours of duty he will repeatedly be detached temporarily to attend special courses related to the duties of his billet; e.g., communication, light antiaircraft, mine sweeping, gas turbine engine. These courses could also be non-job-related such as English language, journalism, and public relations, or specialized training or further education abroad, depending on availability of courses, individual interests, individual abilities, and the availability of funds.

Approximately 5 to 7 years after graduation from the Naval Academy, all officers by year group will be sent to the Junior Officer's College, the general line for 1 year and the engineers' for 2 years of postgraduate education. The course of instruction, however, does not lead to a higher academic degree, and a certificate of completion is acquired. The officer now continues his tours of duty with the same occasional breaks as mentioned earlier to attend special courses, but at a higher level; i.e., Commanding Officers Course, Joint tactics.

After 15 years of experience and holding the rank of lieutenant commander he is sent to the Naval Staff College for 1 year of management-oriented studies as listed in the course outline in Appendix B.

C. PROBLEMS

1. Military Education in General

The Allied military victories of World War II were dazzling with the names of military commanders such as Dwight D. Eisenhower, Sir Bernard L. Montgomery, Douglas MacArthur, Sir Bertram Ramsay, George S. Patton, Jr., Omar N. Bradley, and many more. On the other hand, P.M.S. Blackett, S. Zuckerman, E.J. William, J.B. Conant, P.M. Morse, and over 400 other British and American scientists who conducted operations research were virtually unknown. Their efforts allegedly were instrumental in winning the "Air Battle of Britain," the "Island Campaign in the Pacific," the "Battle of the North Atlantic," etc. (Hillier and Lieberman 1967). Now, one could wonder, why would military commanders have such great need for civilian scientists to aid them in their decision making? They need the scientist's broad education, broad vision, and receptive minds (Trefethen 1954) to cope with the complexity of the modern war. Professor P.M.S. Blackett (1941) stated the following:

> "...very many war operations involve considerations which scientists are specially trained to compete, and in which serving officers are in general not trained. This is especially the case with all those aspects of operation into which probability considerations and the theory of errors enter."

The introduction of operations research to aid military operations indicates the need of increased education for the military officer other than the traditional military professional subjects. Zuckerman (1958) quoted an observation made by the late Field Marshal Lord Wavell in his essays on "Generals and Generalship":

> "... these days the first requirement of generalship is not a flair for tactics and strategy, but a capacity for administration."

Zuckerman (1958) further commented that Lord Wavell's argument was that tactics could hardly be associated with an ignorance of new military

techniques, nor strategy with an unreal conception of what is tactically, administratively, and politically possible. Not only is there a deficiency in military education with regards to wars and tactics but also for the development of the military service in peacetime for its technological growth and peacekeeping role with the civilian world. Vice-Admiral Hyman G. Rickover (1959) reported at a hearing before the Committee on Appropriations, House of Representatives:

> "The midshipmen who graduate from the Naval Academy are about two years behind graduates of our good engineering schools. The reason is that a good deal of their time is taken up with training and not education."

Due to the impact of science, technology, and social and political problems, the priorities for military expertise have changed significantly since World War I, when the basic outline of officer education was set (Huntington 1957). The education of the military officer must then adjust to this change.

2. The Thai Naval Academy

The concept of officer education at the Naval Academy has since its founding in 1898 been more weighted towards training in naval professional subjects and less towards an undergraduate education (Phantumnavin 1955). A major change came in 1954 when the Naval Academy curriculum was revised to be compatible to those of the civilian universities by introducing engineering, physical science, mathematics, and humanity subjects in a more general context. However, the traditional naval professional subjects were still the core of the curriculum. Its structure had a strong similarity to that of the U.S. Naval Academy (1952). In 1967 another revision of the curriculum took place and more humanistic, social, and engineering subjects were added. This revision represents the present curriculum of the Naval Academy. The subjects and instructional breakdown are listed in Appendix A.

Since the 1967 revision, the Naval Academy only produces two distinctly different groups of graduates; namely, the general line and the engineers. The engineers receive four times as many units in academic subjects as naval professional subjects, and of those academic subjects, almost 80% are engineering and science subjects, and 20% humanities and social subjects. The general line, which constitutes the remainder of the "Type A" category, was faced with many problems when the revision study was taking place. First of all, the education had to produce officers who would be utilized in five totally different fields: unrestricted surface line officers; supply officers; aviators; marines; and hydrographic officers. Secondly, what branches of science should be taught as the more professional subjects are reduced? Since this question requires an intensive systems analysis of the navy, and such tools were not available, the branches of science at hand and readily available were chosen -- physical science and engineering. The results of the revision gave the general line slightly more than 60% in academic subjects, with the majority in physical science and engineering, and less than 40% in naval, professional subjects.

One can now question the appropriateness of the curriculum contents, especially the general line's emphasis on engineering and physical science.

D. SOLUTIONS

The deficiencies in Thai military education were realized, and measures were taken to decrease the deficiencies by revising the curriculum in 1954 and 1967, bringing in more academic subjects (Phantumnavin 1955). The revisions did increase the academic status of the Naval Academy curriculum in that from then on, a bachelor of science in naval science was awarded to graduates (Sam Sa-Moa 2513, 1970). However, the appropriateness of the revised curriculum to the Thai naval officer system has never been validated.

Such validation might be done utilizing the systems engineering techniques developed for evaluating training (Crawford 1970; Kraft and Latta 1969). This technique involves: (1) conduct system analysis, (2) develop task inventory, (3) develop job model, (4) conduct task analysis, (5) derive training objectives, (6) develop training program, and (7) monitor trained product and modify training curriculum as required. The systems engineering technique applied to the Thai naval officer system, where very limited statistical data are available, will require several years of research and is beyond the scope of this thesis. Thus, to be able to attain some approximate value of curriculum appropriateness and guidelines to make indicated changes in course content, some other method had to be devised.

The proposed solution is to find the relative importance of the subjects in the curriculum and compare that to the instruction time allocated for the respective subjects. Their correlation coefficient would reflect curriculum appropriateness. Those subjects at the bottom of the importance list could be candidates for deletion or replacement by some other subjects. On the other hand, those subjects of high importance value receiving a small time allocation could be considered to receive more time.

II. METHODOLOGY

Our solution requires us to place the subjects in the curriculum on an interval scale, so that correlation can be performed, and so that distances between subjects can be informative in decision making. To determine the dimension of "importance value" of the subjects in the curriculum, the statement of the mission of the Naval Academy was studied (Chanvirat, 1972). It reads:

> "The mission of the Naval Academy is to provide the cadets with a basic knowledge necessary to the Naval Service, and to develop them in mind and personality as capable leaders so that they may fully dedicate themselves to their country in the achievement of its noble mission, the defense of the nation."

Two distinct dimensions can be recognized; one the importance towards the naval, professional or technical development, and the other, the importance of the academic or intellectual development. These two dimensions must also be on an interval scale, so that multiplicative and additive operations can be justified (Guilford, 1954) to obtain the resulting "importance values" for all subjects in the curriculum.

To measure the "importance value" of subjects for the professional and the academic criteria in such a way that they will fall in interval scales, the method of rank order was considered appropriate. Barrett (1914) comments on this method:

> "Stimuli that have been ranked by a number of observers can be placed in a 'pooled' rank order, and scale values that refer to an interval scale can be assigned to the stimuli. These assigned scale values have been found to be extremely valid when correlated with objective criteria."

Our stimuli, the subjects in the present curriculum of the Naval Academy, will be ranked by naval officers who are graduates of the Naval

Academy. These officers, who will comprise stratified samples representative of the two specialty groups, the general line and the engineers, will henceforth be called "Judges."

Rosenstein (1968), in his studies on educational development programs for UCLA, used formulas to calculate percent instruction time, which was a direct function of subject relevance. We will therefore use the percent instruction time at the Naval Academy as a variable of subject importance.

A. DATA COLLECTION

1. Questionnaire Construction

A survey questionnaire was constructed to collect the ranking of the Naval Academy subjects. The questionnaire (Appendix C) consisted of four pages. Page 1 contained general information on the purpose of the questionnaire, instruction for ranking, and requests for biographical information on the judges. They were asked to make comparisons among those listed subjects they felt confident in distinguishing their importance for the naval profession and to list them in the rank order relative to one another, with ties allowed. Next, they were asked to repeat the procedures again but to change the criterion to the intellectual development of the individual (academic criterion). Page 2 contained the list of 52 subjects contained in the present curriculum of both the general line and the engineers. This list was compared with the subjects in the curriculum prior to the 1954 and 1967 revisions and showed itself to be the superset of those two. Thus, we were confident that subjects taught to those graduates surveyed were included in the list. Pages 3 and 4, identical informat, contained the ranking form for the professional and academic criteria, respectively. The ranking form allowed for 32 ranks and 13 ties. These numbers were derived from a trial questionnaire administered to 21 Thai officers students presently at NPS allowing for all 52 ranks and 13 ties.

(ENG). For each group, the ranking forms were further grouped by criteria, professional (PROF) or academic (ACAD). The resulting four groups were listed as, PROFLINE, ACADLINE, PROFENG, and ACADENG. The forms of the four groups were inspected for errors; those found to have errors were rejected, and the remainder was punched onto IBM cards. The ACADLINE and ACADENG groups lost five and eight questionnaires, respectively, because the ranking forms were received unmarked. The correlation coefficient (r) of the resulting sample to the total officer population dropped from 0.996 for the general line, to 0.901, and from 0.971 for the engineers, to 0.898. The PROFLINE and PROFENG groups lost one and two, respectively, because of the repeated uses of the same subject number. The correlation coefficient (r) to the total officer population dropped from 0.996 for the general line, to 0.994, and from 0.971 for the engineers, to 0.970. The effect from the rejected data was small compared to the resulting correlation coefficients (r).

2. Computation of Weights

The forms for the four groups were processed through the Ford Computer Program (Arima and Mister, 1972; Pelz and Andrew, 1966; Ford, 1957) to compute weights for each subject which would be used for the interval scaling of subjects for each group. The Ford Computer Program is based on forming a win-loss matrix of subject preferences. Then a weight is determined iteratively for each subject so that the set of weights is a maximum likelihood of recapturing the win-loss matrix. The final weight is determined when the weights change less than the convergence criterion (0.005). A more detailed description of usage, flowchart, and program listing are presented in Appendix D.

3. Test for Uniformity of Judges

Since no rule exists as to what number of judges constitute an acceptable sample to generate weights that would reflect the total population,

The mean number of ranks used was 5 and ranged from 2 to a maximum of 11. Accordingly, 32 ranks, which is 70% of the maximum number of subjects given to a midshipman (46) and almost three times the highest number use in the trial questionnaire, were used.

2. Selection of Judges

The distribution by rank and specialty of "Type A" officers in the Thai Navy as of May 1972 is shown in Table 1. This distribution was used to stratify the judges by rank for the sample to be polled. A total of 250 questionnaires, translated and printed in Thai, was sent to the Department of Naval Personnel to be distributed according to the stratified distribution. No confirmation was received of the exact distribution of the questionnaires to the stratified sample. It is, therefore, assumed that the surveyed sample had approximately the total population distribution. After four months, the first batch of questionnaires returned and two months later, the second batch for a total of 77 responses. The distribution of the returned questionnaires shown in Table 2 correlates 0.996 for general line judges and 0.971 for engineer judges at 0.001 level of significance with the distribution of the total officer population in Table 1. The Pearson Product-Moment Correlation Coeficient was used for this test. The result validates the representativeness of our judge group for the total population.

B. DATA ANALYSIS

The data were processed according to the steps and sequences shown in the data processing flowchart, Figure 1.

1. Preparations

The returned questionnaires were separated into those judged by general line officers (LINE), and those judged by engineering officers

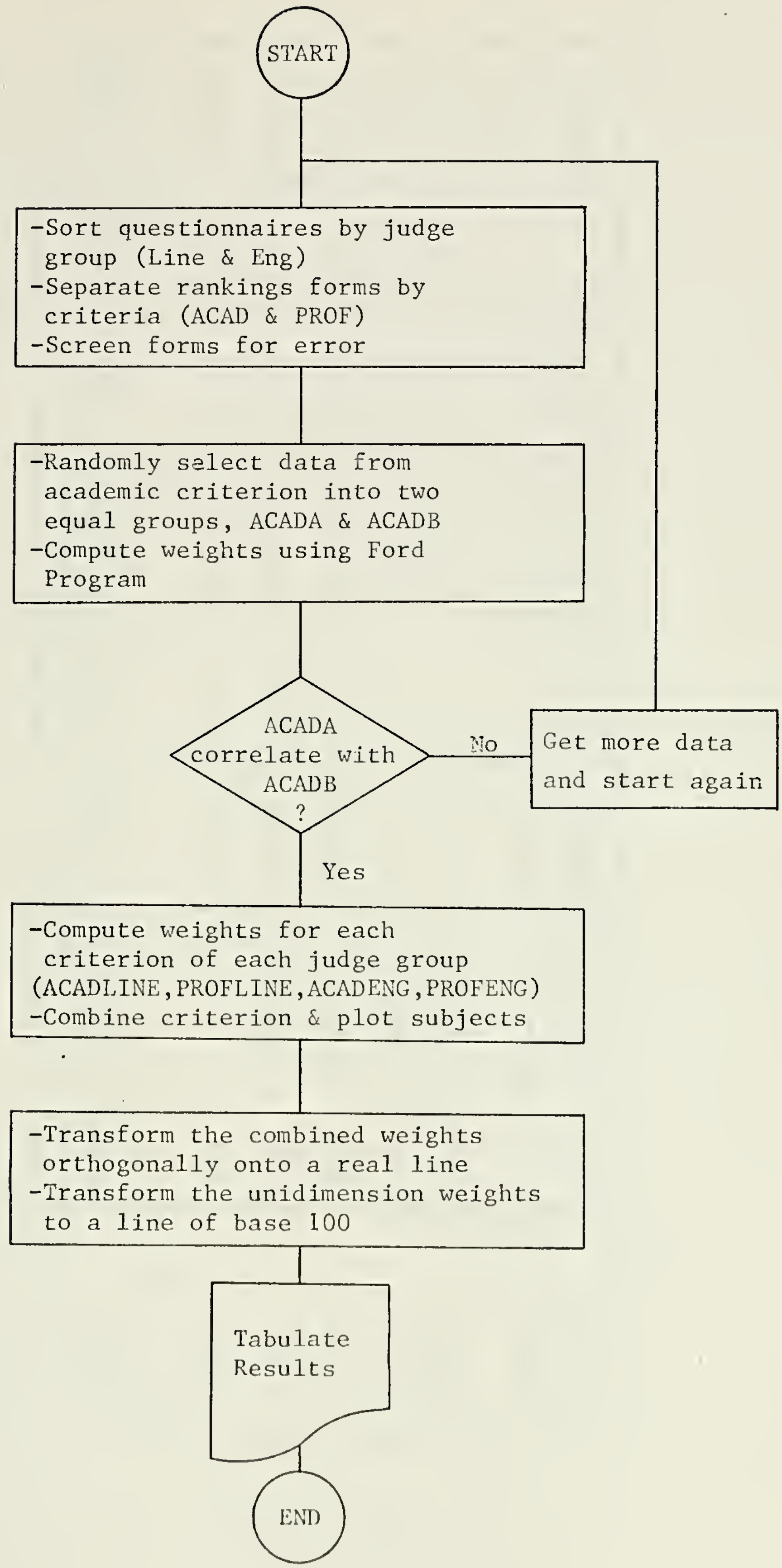

Figure 1. Data Processing Flowchart

TABLE 1.

THE DISTRIBUTIONS OF THAI NAVAL OFFICERS "TYPE A"(LTJG - CAPT).

SPECIALTY	GENERAL LINE OFFICERS			ENGINEERING OFFICERS			RANK TOTAL	
RANK	NUMBER	% SPEC.	% RANK	NUMBER	% SPEC.	% RANK	NUMBER	% RANK
CAPT	129	54.89	22.63	106	45.11	29.20	235	25.46
CDR	146	54.48	25.62	122	45.52	33.61	268	29.03
LCDR	188	73.73	32.98	67	26.27	18.46	255	27.63
LT	79	62.20	13.86	48	37.80	13.22	127	13.76
LTJG	28	58.33	4.91	20	41.67	5.51	48	5.20
TOTAL	570	61.09	100.00	363	38.91	100.00	933	100.00

TABLE 2.

THE DISTRIBUTIONS OF OFFICERS RETURNING THE QUESTIONNAIRES.

SPECIALTY	GENERAL LINE OFFICERS			ENGINEERING OFFICERS			RANK TOTAL	
RANK	NUMBER	% SPEC.	% RANK	NUMBER	% SPEC.	% RANK	NUMBER	% RANK
CAPT	9	50.00	22.00	9	50.00	25.00	18	23.40
CDR	10	47.60	24.40	11	52.40	30.60	21	27.30
LCDR	14	63.60	34.20	8	36.40	22.20	22	28.50
LT	6	54.50	14.60	5	45.50	13.90	11	14.30
LTJG	2	40.00	4.80	3	60.00	8.30	5	6.50
TOTAL	41	53.20	100.00	36	46.80	100.00	77	100.00

a uniformity test was conducted. The data for the academic criterion of both the general line and the engineers were randomly arranged into two groups of 32 judges, designated ACADA and ACADB. These two groups were processed through the Ford Program and the resulting weights correlate against each other using the Pearson Product-Moment Correlation Technique of the Statistical Package for the Social Sciences (Nie. Bent and Hull, 1970). This correlation coefficient (r) was used to determine judge uniformity.

4. Combining the Two Criteria

The two criteria, academic and professional, were assumed to be independent. They can, therefore, be represented by two perpendicular vectors forming a plane. The location of each subject on this plane indicates its importance with respect to the two criteria represented as the two axes. The importance plane for the general line will be represented by ACADLINE and PROFLINE, and similarly for the engineers by ACADENG and PROFENG.

5. Unidimensionizing

Although the two-dimensional representation in (4) above is intuitive, it is not free from ambiguity in interpretation. For decision making we need to reduce it to a one-dimension scale where their distances will reflect the importance of both the academic and the professional criteria and is meaningful for decision making. For this purpose, two transformations were made. First, each subject now located on a plane was mapped orthorgonally onto a real line that was a subset of that same plane; second, the mapped subjects were further mapped onto another parallel line of base 100. The slope of the real line was predetermined by the decision maker's realization of the relative importance of the academic to the professional criteria for the midshipmen. The formula for the transformation is as follows:

$$\text{The final weight for subject } i = \left[\frac{x_i \cos \quad + y_i \sin}{\sum_{j=1}^{52} x_j \cos \quad + y_j \sin} \right] \text{X } 100,\ i=1,\ldots,52$$

where x_i = the weight of subject i on the academic criterion

y_i = the weight of subject i on the professional criterion

= are tan (w_y/w_x)

W_y = scaling factor (1,2) on the professional criterion
W_x = scaling factor (1,2) on the academic criterion

III. RESULTS

The weight computation with the Ford Program required 25 to 48 iterations to convergence (at the 0.005 level), which was consistent with the findings of Arima and Mister (1972). The iterations to convergence for ACADENG (30) and PROFENG (28) were significantly less than for ACADLINE (37) and PROFLINE (48), which shows a higher degree of agreement among the engineer judges compared to the general line. This finding coincides with the fact that the career pattern of the engineers is significantly narrower than that of the general line (Veawsorn, 1973).

A. THE COMPUTED WEIGHTS

The computed weights for both judge groups, broken down into the two criteria, together with the computed weights for the randomly selected test groups, ACADA and ACADB, are listed by their subject number in Table 3. The ranks of the weights are shown in Table 4. Included in these two tables is the percent of instruction time allocated to each subject for the general line and the engineering midshipmen.

The weights of ACADA and ACADB gave a correlation coefficient (r) of 0.908, which is significant at the 0.001 level. It is therefore concluded that the ranking of the judges are highly uniform, and that they reflect the true perception of judges concerning the subjects in the curriculum. The correlation technique used was the Pearson product-moment correlation. In addition cross-correlation was done for all the variables in Table 3 and tabulated in Table 5.

The two rankings of the general line (ACADLINE and PROFLINE) showed no significant correlation with each other ($r = 0.115$). This suggests that

TABLE 3.

WEIGHT TABLE BY CRITERIA.

SBJT	ACAD		LINE		ENG		PCNT TIME	
NO	A	B	PROF	ACAD	ACAD	PROF	LINE	ENG
1	1.062	1.223	2.735	0.424	0.498	0.094	1.830	1.850
2	0.560	1.326	2.280	0.156	0.323	0.047	0.740	0.740
3	0.241	0.373	0.670	0.214	0.041	0.074	3.300	1.110
4	5.670	3.171	5.237	2.037	3.366	1.842	9.700	9.700
5	0.553	0.565	1.056	0.074	0.293	0.101	2.200	2.200
6	1.092	1.005	0.653	0.197	2.705	0.213	1.470	1.470
7	0.802	0.915	0.512	0.125	1.695	0.143	1.470	1.470
8	1.943	1.225	0.853	0.178	3.646	0.381	5.120	5.120
9	0.592	0.900	0.545	0.156	1.211	0.182	0.740	0.740
10	1.384	0.850	0.180	0.137	1.759	0.942	0.0	1.110
11	0.538	0.581	0.447	0.096	0.764	0.164	3.660	3.660
12	0.560	0.620	0.314	0.099	0.655	0.211	0.0	1.470
13	0.825	0.712	0.604	0.166	0.932	0.281	3.400	3.300
14	2.050	1.041	0.908	0.414	2.554	3.628	2.570	3.480
15	2.816	1.128	1.159	0.363	2.558	1.392	5.490	5.490
16	1.671	1.185	1.181	0.090	1.454	0.249	1.110	1.110
17	0.142	0.227	0.080	0.068	0.262	0.423	2.900	2.900
18	0.129	0.111	0.085	0.038	0.100	0.350	0.740	0.740
19	0.529	0.554	0.335	0.097	1.098	0.444	2.200	2.200
20	0.887	0.556	0.385	0.051	0.837	0.302	2.200	2.200
21	0.335	0.380	0.192	0.035	0.385	0.367	1.470	2.900
22	0.392	0.405	0.229	0.087	0.458	0.434	1.470	2.900
23	0.303	0.453	0.194	0.022	0.352	0.432	0.0	2.200
24	0.261	0.263	0.055	0.167	0.339	0.792	0.0	2.900
25	0.164	0.133	0.079	0.108	0.155	1.593	1.110	1.110
26	0.252	0.101	0.133	0.120	0.114	2.051	2.200	2.200
27	0.548	0.299	0.296	0.271	0.467	3.701	1.470	1.470
28	0.278	0.777	0.270	0.039	0.562	0.690	1.470	3.660
29	0.107	0.334	0.177	0.195	0.195	1.067	1.470	1.470
30	0.186	0.670	0.280	0.017	0.282	0.602	0.0	1.470
31	0.102	0.204	0.114	0.082	0.185	0.400	0.0	2.900
32	0.187	0.139	0.081	0.042	0.137	0.401	0.0	0.740
33	0.031	0.085	0.058	0.324	0.043	0.114	3.300	3.050
34	1.053	0.511	1.051	1.967	0.304	0.729	1.110	1.110
35	0.102	0.247	0.240	0.500	0.088	0.292	1.470	1.470
36	0.040	0.152	0.096	0.110	0.059	0.025	0.740	0.740
37	0.161	0.100	0.377	0.124	0.024	0.052	1.110	1.110
38	0.193	0.313	0.386	7.422	0.080	0.252	3.050	3.050
39	0.217	0.386	0.547	7.518	0.064	0.218	5.120	5.120
40	0.093	0.226	0.244	0.385	0.033	0.067	1.110	1.110
41	0.077	0.270	0.271	0.247	0.034	0.058	1.110	1.110
42	0.147	0.238	0.274	2.594	0.048	0.091	2.900	0.0
43	0.220	0.317	0.378	1.980	0.067	0.064	0.740	0.0
44	0.125	0.214	0.249	1.049	0.037	0.082	1.110	0.0
45	0.131	0.148	0.216	0.339	0.027	0.134	5.620	2.350
46	0.152	0.149	0.198	0.679	0.044	0.115	1.830	0.0
47	0.159	0.155	0.199	0.623	0.048	0.159	1.960	0.0
48	0.157	0.191	0.204	0.772	0.061	0.208	2.200	0.0
49	0.267	0.354	0.411	0.338	0.133	0.094	0.740	0.0
50	0.170	0.356	0.412	0.179	0.085	0.054	0.740	0.0
51	0.101	0.100	0.147	0.628	0.020	0.131	0.930	0.0
52	0.232	0.258	0.271	0.312	0.176	0.107	1.610	1.610

TABLE 4.

RANK TABLE BY CRITERIA.

SBJT	ACAD		LINE		ENG		PCNT TIME	
NO	A	B	PROF	ACAD	ACAD	PROF	LINE	ENG
1	8	4	2	13	16	42	20	22
2	14	2	3	30	22	51	39	39
3	27	25	10	23	46	45	8	31
4	1	1	1	4	2	4	1	1
5	16	17	6	44	24	40	14	17
6	7	8	11	24	3	28	23	24
7	12	9	15	33	7	34	23	24
8	4	3	9	27	1	19	4	3
9	13	10	14	31	9	31	39	39
10	6	11	41	32	6	8	46	31
11	18	16	16	40	13	32	6	5
12	15	15	24	38	14	29	46	24
13	11	13	12	29	11	24	7	8
14	3	7	8	14	5	2	13	7
15	2	6	5	16	4	6	3	2
16	5	5	4	41	8	26	31	31
17	41	37	49	45	26	16	11	11
18	43	48	47	49	34	21	39	39
19	19	19	23	39	10	13	14	17
20	10	18	20	46	12	22	14	17
21	21	24	40	50	19	20	23	11
22	20	22	34	42	18	14	23	11
23	22	21	39	51	20	15	46	17
24	25	33	52	28	21	9	46	11
25	35	47	50	37	30	5	31	31
26	26	49	44	35	33	3	14	17
27	17	31	25	21	17	1	23	24
28	23	12	30	48	15	11	23	5
29	45	28	42	25	27	7	23	24
30	33	14	26	52	25	12	46	24
31	47	40	45	43	28	18	46	11
32	32	46	48	47	31	17	46	39
33	52	52	51	19	45	38	8	9
34	9	20	7	6	23	10	31	31
35	46	35	33	12	35	23	23	24
36	51	43	46	36	41	52	39	39
37	36	51	22	34	51	50	31	31
38	31	30	19	2	37	25	10	9
39	30	23	13	1	39	27	4	3
40	49	38	32	15	49	46	31	31
41	50	32	29	22	48	48	31	31
42	40	36	27	3	42	43	11	44
43	29	29	21	5	38	47	39	44
44	44	39	31	7	47	44	31	44
45	42	45	35	17	50	35	2	16
46	39	44	38	9	44	37	20	44
47	37	42	37	11	43	33	19	44
48	38	41	36	8	40	30	14	44
49	24	27	18	18	32	41	39	44
50	34	26	17	26	36	49	39	44
51	48	50	43	10	52	36	38	44
52	28	34	28	20	29	39	22	23

TABLE 5.

CORRELATION MATRIX BY GROUP BY CRITERIA.

	ACAD A	ACAD B	ACAD LINE	PROF LINE	ACAD ENG	PROF ENG	TIME LINE
ACAD B	.908**						
ACADLINE	.819**	.890**					
PROFLINE	.031	.012	.225				
ACADENG	.831**	.788**	.513**	-.102			
PROFENG	.437**	.242+	.174	-.059	.354*		
TIMELINE	.640**	.521**	.565**	.343*	.472**	.179	
TIMEENG	.709**	.637**	.555**	.235+	.598**	.334*	.760**

** SIGNIFICANT AT .001 LEVEL
* SIGNIFICANT AT .01 LEVEL
+ SIGNIFICANT AT .05 LEVEL

PEARSON PRODUCT-MOMENT CORRELATION

for the general line officer, subjects that impact on the nature of his work do not have any significant correlation with his academic development. However, for the engineer, it is different; ACADENG and PROFENG correlate significantly with each other ($r = 0.354$) at the 0.01 level of significance. Therefore, for the engineer, there is a relationship among subjects that impact in his work and those that are significant for his academic development.

Having combined the two criterion together, ACADLIN with PROFLINE for the general line and ACADENG with PROFENG for the engineers, to form the locations on the importance plane for each subject according to judge group, the subjects are plotted in Figure 2 for the general line and Figure 3 for the engineers. Due to uneven concentration of subject locations, both Figure 2 and Figure 3 consist of an enlarged scaled plot on the left and a reduced scaled plot on the right. These two figures show each subject's relative importance to one another with respect to the two criteria, with the south-west corner as the least important and the north-east corner the most important. The approximate contribution of a subject to the two criteria could be determined by its distance from the axes; the nearer to that axis the more it contributes to that criterion. For example, by studying Figure 2, we could see that subjects numbers 42, 43, 44, 38, and 39 contribute significantly more to the professional criterion than to the academic criterion. In general, Figure 2 shows that for the general line, professional subjects contribute mostly to the professional criterion, while science, engineering, humanities, and social subjects contribute almost entirely to the academic criterion. In contrast is the case of the engineers in Figure 3, where most of the professional subjects are considered to be of no significant importance, very few of little importance to the professional criterion, and only one (number 34) of significant value to both

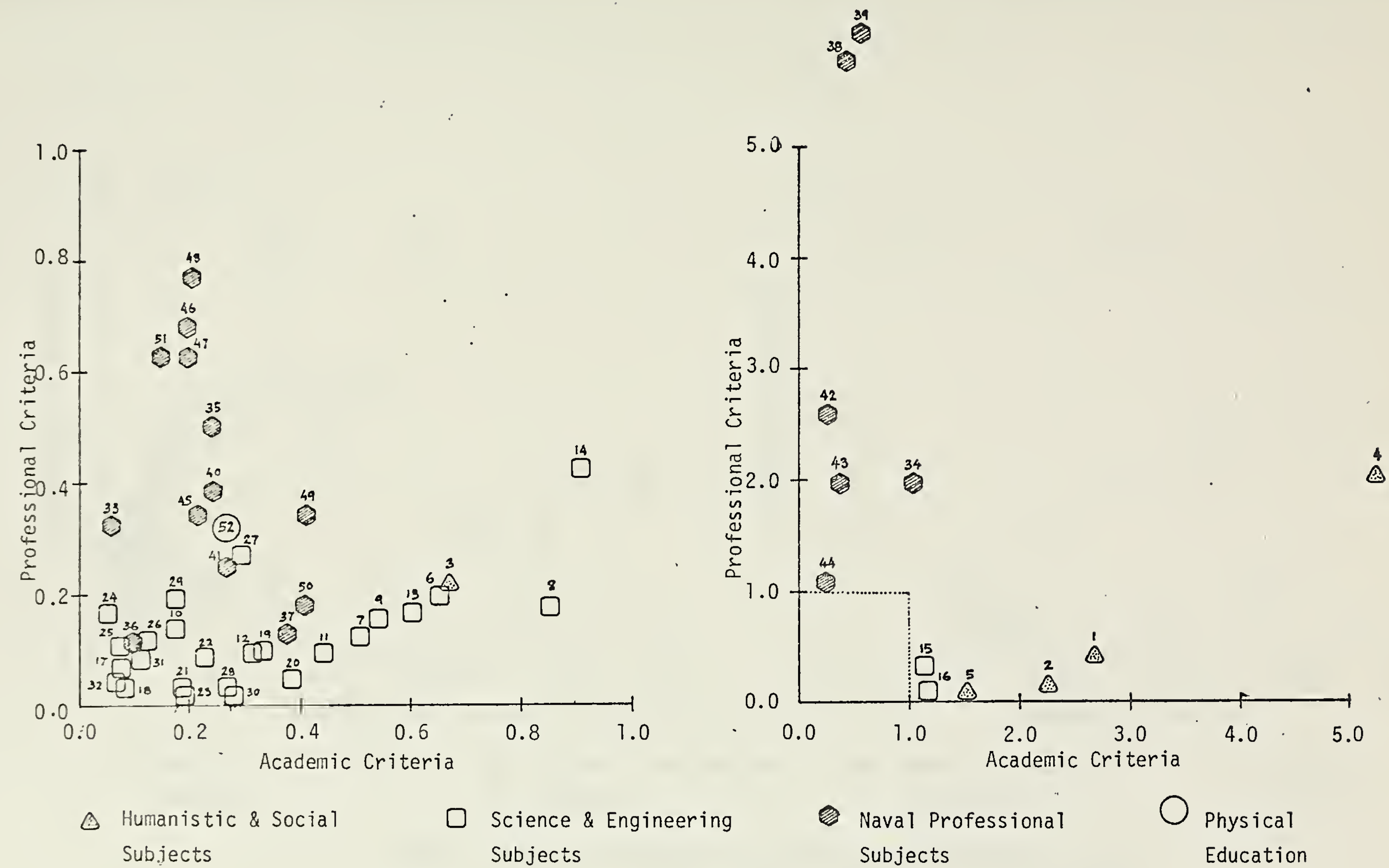

FIGURE 2. IMPORTANCE PLOT OF SUBJECTS FOR THE GENERAL LINE OFFICER

FIGURE 3. IMPORTANCE PLOT OF SUBJECTS FOR THE ENGINEERING OFFICER

criteria. Also for the engineers, humanities and social subjects are of little importance with the exception of one (number 4). Science and engineering subjects, however, are equally important with few exceptions to both criteria. Physical Education (number 52) is considered relatively unimportant for both the general line and the engineers.

B. UNIDIMENSIONIZING

The dimension reducing transformations was done three times each for the general line and the engineers. Each time the ratio of the relative importance between the two criteria was changed; 1 to 2, 1 to 1, and 2 to 1 were used. The unidimensional weights are listed in Table 6; their transformation to a base 100 (percent), in Table 7; and their ranks, in Table 8. Comparisons of the ranks in Table 8 were made against the ranks of the time allocations and their differences listed in Table 9. Both the unidimension weights and their ranks were cross-correlated, the former using the Pearson product-moment correlation tabulated in Table 10, and the latter using Spearman's rank-order correlation, tabulated in Table 11.

The extremely high correlations between the sets of unidimension weights ($r = 0.976$, $r = 0.870$, $r = 0.956$) and the unidimension ranks ($\rho = 0.980$, $\rho = 0.932$, $\rho = 0.982$), suggest a relatively low senstivity in ratio changes of criterion importance for the tested range (no greater than double.)

A critical inspection of the subjects for their appropriateness utilizes the rank difference table, Table 9. The listing shows both negative and positive numbers for each subject; the negative signs indicate the rank of the time allocation was lower than the rank of the computed unidimensional weight, and the positive sign, vice versa. Large numbers of either sign show high disagreement in rank between the computed unidimensional weight and the percent of time allocation; e.g., subject number 17 for the general line has 39 in rank difference, meaning that a sizeable allocation of

TABLE 6.

UNIDIMENSIONAL WEIGHTS FOR EACH SUBJECTS.

SBJT	LINE			ENG			PCNT TIME	
NO	1:2	1:1	2:1	1:2	1:1	2:1	LINE	ENG
1	1.602	2.234	2.636	0.307	0.418	0.487	1.830	1.850
2	1.159	1.722	2.109	0.187	0.262	0.310	0.740	0.740
3	0.491	0.625	0.695	0.085	0.081	0.070	3.300	1.110
4	4.164	5.144	5.595	3.153	3.682	3.834	9.700	9.700
5	0.539	0.799	0.978	0.221	0.278	0.307	2.200	2.200
6	0.468	0.601	0.672	1.400	2.063	2.515	1.470	1.470
7	0.341	0.451	0.514	0.887	1.300	1.581	1.470	1.470
8	0.541	0.729	0.843	1.972	2.848	3.432	5.120	5.120
9	0.383	0.495	0.557	0.705	0.985	1.165	0.740	0.740
10	0.203	0.224	0.222	1.629	1.909	1.994	0.0	1.110
11	0.286	0.384	0.443	0.488	0.656	0.756	3.660	3.660
12	0.229	0.292	0.325	0.482	0.612	0.680	0.0	1.470
13	0.419	0.545	0.614	0.668	0.858	0.959	3.400	3.300
14	0.776	0.935	0.997	4.387	4.371	3.907	2.570	3.480
15	0.843	1.076	1.199	2.389	2.793	2.910	5.490	5.490
16	0.609	0.899	1.097	0.873	1.204	1.412	1.110	1.110
17	0.096	0.104	0.102	0.495	0.484	0.424	2.900	2.900
18	0.072	0.087	0.093	0.358	0.318	0.246	0.740	0.740
19	0.237	0.306	0.343	0.888	1.090	1.180	2.200	2.200
20	0.218	0.308	0.367	0.644	0.805	0.884	2.200	2.200
21	0.118	0.161	0.188	0.500	0.532	0.508	1.470	2.900
22	0.180	0.223	0.244	0.593	0.631	0.604	1.470	2.900
23	0.106	0.152	0.183	0.544	0.554	0.508	0.0	2.200
24	0.174	0.157	0.124	0.860	0.800	0.658	0.0	2.900
25	0.131	0.132	0.119	1.494	1.236	0.851	1.110	1.110
26	0.167	0.179	0.173	1.886	1.531	1.020	2.200	2.200
27	0.375	0.401	0.386	3.519	2.947	2.073	1.470	1.470
28	0.156	0.219	0.259	0.868	0.885	0.811	1.470	3.660
29	0.254	0.263	0.245	1.042	0.893	0.652	1.470	1.470
30	0.141	0.210	0.258	0.665	0.625	0.522	0.0	1.470
31	0.125	0.139	0.139	0.440	0.413	0.344	0.0	2.900
32	0.074	0.087	0.091	0.420	0.380	0.302	0.0	0.740
33	0.316	0.270	0.197	0.122	0.111	0.090	3.300	3.050
34	2.230	2.134	1.820	0.788	0.731	0.598	1.110	1.110
35	0.554	0.523	0.438	0.300	0.269	0.209	1.470	1.470
36	0.142	0.146	0.135	0.049	0.059	0.064	0.740	0.740
37	0.280	0.354	0.393	0.057	0.053	0.044	1.110	1.110
38	6.811	5.522	3.665	0.261	0.234	0.184	3.050	3.050
39	6.969	5.703	3.851	0.223	0.199	0.155	5.120	5.120
40	0.454	0.445	0.391	0.075	0.071	0.060	1.110	1.110
41	0.342	0.366	0.353	0.067	0.065	0.056	1.110	1.110
42	2.443	2.028	1.406	0.103	0.099	0.084	2.900	0.0
43	1.940	1.667	1.223	0.087	0.093	0.089	0.740	0.0
44	1.049	0.917	0.691	0.090	0.084	0.070	1.110	0.0
45	0.400	0.392	0.345	0.132	0.114	0.084	5.620	2.350
46	0.696	0.620	0.481	0.122	0.112	0.091	1.830	0.0
47	0.646	0.581	0.457	0.164	0.146	0.114	1.960	0.0
48	0.781	0.690	0.527	0.214	0.191	0.148	2.200	0.0
49	0.486	0.530	0.519	0.144	0.161	0.161	0.740	0.0
50	0.345	0.418	0.449	0.086	0.098	0.100	0.740	0.0
51	0.628	0.548	0.412	0.126	0.107	0.076	0.930	0.0
52	0.400	0.412	0.382	0.174	0.200	0.205	1.610	1.610

TABLE 7.

NORMALIZED TABLE OF UNIDIMENSIONAL WEIGHTS.

SBJT	LINE			ENG			PCNT TIME	
NO	1:2	1:1	2:1	1:2	1:1	2:1	LINE	ENG
1	3.676	5.013	6.438	0.798	1.005	1.201	1.830	1.850
2	2.660	3.866	5.151	0.486	0.629	0.765	0.740	0.740
3	1.127	1.403	1.697	0.220	0.195	0.171	3.300	1.110
4	9.554	11.545	13.665	8.204	8.842	9.447	9.700	9.700
5	1.236	1.794	2.388	0.575	0.669	0.757	2.200	2.200
6	1.074	1.348	1.641	3.643	4.954	6.196	1.470	1.470
7	0.783	1.012	1.256	2.307	3.122	3.894	1.470	1.470
8	1.241	1.637	2.058	5.131	6.839	8.456	5.120	5.120
9	0.878	1.112	1.360	1.834	2.366	2.870	0.740	0.740
10	0.465	0.502	0.542	4.238	4.585	4.914	0.0	1.110
11	0.656	0.862	1.082	1.270	1.575	1.864	3.660	3.660
12	0.525	0.655	0.794	1.254	1.471	1.676	0.0	1.470
13	0.961	1.222	1.501	1.739	2.060	2.364	3.400	3.300
14	1.781	2.098	2.436	11.416	10.496	9.626	2.570	3.480
15	1.934	2.415	2.928	6.216	6.706	7.171	5.490	5.490
16	1.396	2.017	2.679	2.272	2.892	3.479	1.110	1.110
17	0.221	0.234	0.248	1.289	1.163	1.044	2.900	2.900
18	0.165	0.195	0.227	0.931	0.764	0.606	0.740	0.740
19	0.543	0.686	0.838	2.311	2.618	2.908	2.200	2.200
20	0.500	0.692	0.897	1.677	1.934	2.177	2.200	2.200
21	0.270	0.361	0.458	1.302	1.277	1.253	1.470	2.900
22	0.413	0.502	0.596	1.544	1.515	1.488	1.470	2.900
23	0.243	0.342	0.447	1.415	1.331	1.252	0.0	2.200
24	0.400	0.352	0.302	2.238	1.921	1.620	0.0	2.900
25	0.302	0.296	0.290	3.887	2.967	2.096	1.110	1.110
26	0.383	0.402	0.422	4.907	3.677	2.512	2.200	2.200
27	0.859	0.900	0.942	9.157	7.077	5.107	1.470	1.470
28	0.358	0.491	0.633	2.259	2.125	1.998	1.470	3.660
29	0.582	0.590	0.599	2.711	2.144	1.607	1.470	1.470
30	0.323	0.472	0.630	1.730	1.502	1.286	0.0	1.470
31	0.286	0.312	0.340	1.145	0.992	0.847	0.0	2.900
32	0.170	0.195	0.223	1.093	0.914	0.743	0.0	0.740
33	0.724	0.606	0.480	0.317	0.268	0.221	3.300	3.050
34	5.116	4.791	4.445	2.050	1.754	1.474	1.110	1.110
35	1.272	1.174	1.070	0.781	0.645	0.515	1.470	1.470
36	0.325	0.328	0.331	0.127	0.142	0.157	0.740	0.740
37	0.642	0.796	0.959	0.148	0.128	0.109	1.110	1.110
38	15.628	12.394	8.951	0.678	0.562	0.453	3.050	3.050
39	15.990	12.801	9.407	0.581	0.479	0.381	5.120	5.120
40	1.041	0.999	0.955	0.194	0.170	0.147	1.110	1.110
41	0.784	0.821	0.861	0.174	0.156	0.139	1.110	1.110
42	5.605	4.553	3.433	0.269	0.237	0.207	2.900	0.0
43	4.451	3.743	2.988	0.227	0.223	0.219	0.740	0.0
44	2.407	2.059	1.688	0.233	0.202	0.172	1.110	0.0
45	0.917	0.881	0.842	0.342	0.273	0.207	5.620	2.350
46	1.596	1.391	1.174	0.318	0.270	0.224	1.830	0.0
47	1.482	1.304	1.115	0.426	0.352	0.281	1.960	0.0
48	1.793	1.548	1.288	0.556	0.458	0.365	2.200	0.0
49	1.116	1.189	1.268	0.374	0.386	0.397	0.740	0.0
50	0.791	0.939	1.096	0.225	0.236	0.247	0.740	0.0
51	1.440	1.230	1.007	0.329	0.256	0.188	0.930	0.0
52	0.919	0.926	0.933	0.452	0.479	0.504	1.610	1.610

TABLE 8.

RANK OF UNIDIMENSIONAL WEIGHTS.

SBJT	LINE			ENG			FONT TIME	
NO	1:2	1:1	2:1	1:2	1:1	2:1	LINE	ENG
1	7	4	4	30	27	26	20	22
2	8	7	5	36	33	29	39	39
3	20	16	14	48	48	48	8	31
4	3	3	1	3	2	2	1	1
5	19	13	12	34	31	30	14	17
6	22	18	16	9	6	5	23	24
7	31	25	21	12	9	8	23	24
8	18	14	13	5	4	3	4	3
9	27	24	18	17	13	11	39	39
10	39	39	41	7	7	7	46	31
11	33	31	25	25	20	17	6	5
12	37	36	36	26	23	18	46	24
13	24	21	17	18	16	13	7	8
14	12	10	11	1	1	1	13	7
15	10	9	9	4	5	4	3	2
16	16	12	10	13	11	9	31	31
17	50	50	50	24	26	27	11	11
18	52	52	51	29	30	32	39	39
19	36	35	35	11	12	10	14	17
20	38	34	32	20	17	14	14	17
21	48	44	43	23	25	24	23	11
22	40	40	40	21	21	21	23	11
23	49	46	44	22	24	25	46	17
24	41	45	48	15	18	19	46	11
25	46	49	49	8	10	15	31	31
26	42	43	45	6	8	12	14	17
27	28	29	30	2	3	6	23	24
28	43	41	37	14	15	16	23	5
29	35	38	39	10	14	20	23	24
30	45	42	38	19	22	23	46	24
31	47	48	46	27	28	28	46	11
32	51	51	52	28	29	31	46	39
33	32	37	42	43	42	42	8	9
34	5	5	6	16	19	22	31	31
35	17	23	26	31	32	33	23	24
36	44	47	47	52	51	49	39	39
37	34	33	28	51	52	52	31	31
38	2	2	3	32	34	35	10	9
39	1	1	2	33	36	37	4	3
40	23	26	29	49	49	50	31	31
41	30	32	33	50	50	51	31	31
42	4	6	7	44	44	45	11	44
43	6	8	8	46	46	43	39	44
44	9	11	15	45	47	47	31	44
45	26	30	34	40	40	44	2	16
46	13	17	22	42	41	41	20	44
47	14	19	23	38	39	39	19	44
48	11	15	19	35	37	38	14	44
49	21	22	20	39	38	36	39	44
50	29	27	24	47	45	40	39	44
51	15	20	27	41	43	46	38	44
52	25	28	31	37	35	34	22	23

TABLE 9.

RANK DIFFERENCE OF UNIDIMENSIONAL WEIGHTS.

SBJT	LINE			ENG			PCNT TIME	
NO	1:2	1:1	2:1	1:2	1:1	2:1	LINE	ENG
1	-13	-16	-16	8	5	4	20	22
2	-31	-32	-34	-3	-6	-10	39	39
3	12	8	6	17	17	17	8	31
4	2	2	0	2	1	1	1	1
5	5	-1	-2	17	14	13	14	17
6	-1	-5	-7	-15	-18	-19	23	24
7	8	2	-2	-12	-15	-16	23	24
8	14	10	9	2	1	0	4	3
9	-12	-15	-21	-22	-26	-28	39	39
10	-7	-7	-5	-24	-24	-24	46	31
11	27	25	19	20	15	12	6	5
12	-9	-10	-10	2	-1	-6	46	24
13	17	14	10	10	8	5	7	8
14	-1	-3	-2	-6	-6	-6	13	7
15	7	6	6	2	3	2	3	2
16	-15	-19	-21	-18	-20	-22	31	31
17	39	39	39	13	15	16	11	11
18	13	13	12	-10	-9	-7	39	39
19	22	21	21	-6	-5	-7	14	17
20	24	20	18	3	0	-3	14	17
21	25	21	20	12	14	13	23	11
22	17	17	17	10	10	10	23	11
23	3	0	-2	5	7	8	46	17
24	-5	-1	2	4	7	8	46	11
25	15	18	18	-23	-21	-16	31	31
26	28	29	31	-11	-9	-5	14	17
27	5	6	7	-22	-21	-18	23	24
28	20	18	14	9	10	11	23	5
29	12	15	16	-14	-10	-4	23	24
30	-1	-4	-8	-5	-2	-1	46	24
31	1	2	0	16	17	17	46	11
32	5	5	6	-11	-10	-8	46	39
33	24	29	34	34	33	33	8	9
34	-26	-26	-25	-15	-12	-9	31	31
35	-6	0	3	7	8	9	23	24
36	5	8	8	13	12	10	39	39
37	3	2	-3	20	21	21	31	31
38	-8	-8	-7	23	25	26	10	9
39	-3	-3	-2	30	33	34	4	3
40	-8	-5	-2	18	18	19	31	31
41	-1	1	2	19	19	20	31	31
42	-7	-5	-4	0	0	1	11	44
43	-33	-31	-31	2	2	-1	39	44
44	-22	-20	-16	1	3	3	31	44
45	24	28	32	24	24	28	2	16
46	-7	-3	2	-2	-3	-3	20	44
47	-5	0	4	-6	-5	-5	19	44
48	-3	1	5	-9	-7	-6	14	44
49	-18	-17	-19	-5	-6	-8	39	44
50	-10	-12	-15	3	1	-4	39	44
51	-23	-18	-11	-3	-1	2	38	44
52	3	6	9	14	12	11	22	23

TABLE 10.

CORRELATION MATRIX OF UNIDIMENSIONAL WEIGHTS

	LINE 1:2	LINE 1:1	LINE 2:1	ENG 1:2	ENG 1:1	ENG 2:1	TIME LINE
LINE 1:1	.976**						
LINE 2:1	.870**	.956**					
ENG 1:2	.010	.092	.195				
ENG 1:1	.020	.118	.242+	.973**			
ENG 2:1	.029	.138	.274+	.900**	.976**		
TIMELINE	.469**	.549**	.615**	.342*	.407**	.449**	
TIMEENG	.365*	.454**	.540**	.514**	.576**	.607**	.760**

** SIGNIFICANT AT .001 LEVEL
* SIGNIFICANT AT .01 LEVEL
+ SIGNIFICANT AT .05 LEVEL

PEARSON PRODUCT-MOMENT CORRELATION

TABLE 11.

CORRELATION MATRIX OF UNIDIMENSIONAL RANKS

	LINE 1:2	LINE 1:1	LINE 2:1	ENG 1:2	ENG 1:1	ENG 2:1	TIME LINE
LINE 1:1	.980**						
LINE 2:1	.932**	.982**					
ENG 1:2	-.174	-.100	-.053				
ENG 1:1	-.156	-.070	-.011	.990**			
ENG 2:1	-.135	-.036	.035	.964**	.988**		
TIMELINE	.423*	.436**	.417*	.131	.145	.134	
TIMEENG	-.117	-.055	-.013	.523**	.522**	.519**	.530**

** SIGNIFICANT AT .001 LEVEL
* SIGNIFICANT AT .01 LEVEL
+ SIGNIFICANT AT .05 LEVEL

SPEARMAN RANK-ORDER CORRELATION

time was given to an unimportant subject (Graphic Science), and Tables 7 and 8 show that subject number 17 was allocated 2.9% of instruction time (rank 11), but was only weighted at 0.2 (rank 50).

IV. CONCLUSIONS AND RECOMMENDATIONS

The results of this study point out that the allocation of instruction times for several subjects in the curriculum are inappropriate, and that some adjusting should be conducted. The direction of adjustment as suggested could be safely followed, but the magnitude should be used with caution. Even though subject relevancies and percent instruction time are supposedly directly proportional, this would not hold if there were great differences in the intrinsic time requirements of subjects. For example, a specific subject could be highly important but because its intrinsic time requirement is very small, the instruction time allocated could be insignificant. So, subjective judgment is also required to correctly make adjustments.

The author must agree that two dimensions used to signify the importance of subjects is very coarse, but it was desirable to keep this study as simple as possible considering the experience of the judges. As further revisions of the curriculum are made and more humanities, social, environmental, management, and other science courses are brought in and taught according to their needs, more dimensions could be included in future surveys.

APPENDIX A

Course Content - Naval Academy, General Line

Subject	Class	Credit	Percentage
Humanity and Social			
Law	4.5	5	1.83
International Relation	5	2	0.74
Naval History	3.4	9	3.30
English Language	1,2,3,4,5	26½	9.70
French Language	4,5	6	2.20
Total		48½	17.79
Science and Engineering			
Algebra	1	4	1.47
Analytic Geometry	1	4	1.47
Calculus	1,2,3	14	5.12
Spherical Trigonometry	2	2	0.74
Chemistry	1	10	3.66
Physics	2	9	3.40
Electrical Power	3	7	2.57
Electronics	4,5	15	5.49
Computers	5	3	1.11
Graphic Science	1	8	2.90
Work Shop	1	2	0.74
Mechanics	2	6	2.20
Fluid Mechanics	3	6	2.20
Material Science	2	4	1.47
Strength of Materials	3	4	1.47
Boiler	2	3	1.11
Steam Engine	2	6	2.20
International Combustion Engine	2	4	1.47
Thermodynamics	3	4	1.47
Ship's Stability and Buoyancy	4	4	1.47
Total		119	43.71
Naval Professional Subjects			
Infantry	1,2,3,4,5	9	3.30
Leadership	4	3	1.11
Naval Instructor	5	4	1.47
Naval Hygiene	2	2	0.74
Material and Financial Management	5	3	1.11

Seamanship	1,2,3	8½	3.05
Navigation	1,2,3	14	5.12
Meteorology	3	3	1.11
Oceanography	5	3	1.11
Naval Operation	4,5	8	2.90
Communication	5	2	0.74
CIC and Lookout	4	3	1.11
Gunnery	3,4,5	15½	5.62
Torpedo	4,5	5	1.83
Mine	4,5	5½	1.96
Antisubmarine Weapons	4,5	6	2.20
Rockets and Guided Missiles	5	2	0.74
Nuclear Weapons	5	2	0.74
Amphibious Warfare	5	2½	0.93
Total		101	36.39

Course Content - Naval Academy, Engineers

Humanity and Social

Law	4,5	5	1.85
International Relations	5	2	0.74
Naval History	3	3	1.11
English Language	1,2,3,4,5	26½	9.70
French Language	4,5	6	2.20
Total		42½	15.60

Science and Engineering

Algebra	1	4	1.47
Analytic Geometry	1	4	1.47
Calculus	1,2,3	14	5.12
Spherical Trigonometry	2	2	0.74
Mathematics for Engineers	4	3	1.11
Chemistry	1	10	3.66
Applied Chemistry for Engineering	5	4	1.47
Physics	2	9	3.30
Electrical Power	3,4	9½	3.48
Electronics	4,5	15	5.49
Computers	5	3	1.11
Graphic Science	1	8	2.90
Work Shop	1	2	0.74
Mechanics	2	6	2.20
Fluid Mechanics	3	6	2.20
Material Science	2,4	8	2.90
Strength of Materials	3,4	8	2.90
Kinematics	4	6	2.20
Machine Design	5	8	2.90
Boiler	2	3	1.11
Steam Engine	2	6	2.20
Internal Combustion Engine	2	4	1.47

Thermodynamics	3,4	10	3.66
Ship's Stability and Buoyancy	4	4	1.47
Heat Transfer	5	4	1.47
Naval Architecture	5	8	2.90
Work Shop Technology	5	2	0.74
Total		170½	62.57

Naval Professional Subject

Infantry	1,2,3,4	8½	3.05
Leadership	4	3	1.11
Naval Instructor	5	4	1.47
Naval Hygiene	2	2	0.74
Material and Financial Management	5	3	1.11
Seamanship	1,2,3	8½	3.05
Navigation	1,2,3	14	5.12
Meteorology	3	3	1.11
Oceanography	5	3	1.11
Gunnery	3	6½	2.35
Total		55	20.22

APPENDIX B

Course Content - Junior Officers College General Line
(48 Weeks)

Naval Administrative Section

Basic Staff Works
Personnel Administration
Intelligence
Logistics
Communication

International Affairs

International Law

Foreign Languages

English

Strategy and Tactics Section

Naval Strategy
Naval Operations
Joint Operations
Naval Weapons
Nuclear Weapons
Combat Information Center

Modern Mathematics

Linear Programming
Probability and Theory of Games

Course Content - Juniors Officers College Engineering
(80 Weeks)

Vector and Matrices
Ordinary Differentials Equation
Partial Differentiation
Numerical Methods
Digital Computation
Probability and Statistics
Nuclear Power Plant
Industrial Management
Dynamics of Machinery
Advanced Fluid Mechanics
Machine Design
Applied Thermodynamics
Engineering Metallurgy

Naval Architecture
A.C. Circuits
D.C. Machinery
A.C. Machinery
Line and Network System
Transients
Servomechanism
Advanced Servomechanism
Magnetic Amplifiers
Electronics
Applied Chemistry
Marine Power Plants
Operations Analysis

APPENDIX C

SURVEY QUESTIONNAIRE

Page 1

The Appropriateness of the Thai Naval Academy Curriculum

This survey is conducted to gain insights on the appropriateness of the Thai Naval Academy Curriculum. Two criteria are used to determine the subjects' importance: the professional criterion, its contribution to the naval profession; the academic criterion, its contribution to the intelligence development of the individual. You are asked to rank only those of the listed subjects you feel competent of giving judgment.

Instructions

1. Please fill in the blanks (page 1).

Rank,Name............................Branch.............Year Group.........

Position.....................Shore duties........yrs,Sea duties........yrs

Have been overseas.....times.......yrs,Command......times,EDO........times

Double promotion.......times,No promotion........times,Other degree.......

Marital status.................Number of children........................

2. Study the subject list on page 2, and delete those not being considered.

3. Arrange the considered subjects according to their relative importance to your work since graduation, and rank them using their I.D. numbers using the form on page 3.

4. Arrange the considered subjects according to their relative importance to your intellectual development, and rank them using their I.D. number using the form on page 4.

Thank you very much for your cooperation.

List of Subjects with I.D. Number

1. Law
2. International Relations
3. Naval History
4. English Language
5. French Language
6. Algebra
7. Analytic Geometry
8. Calculus
9. Spherical Trigonometry
10. Mathematics for Engineers
11. Chemistry
12. Applied Chemistry for Engineering
13. Physics
14. Electrical Power
15. Electronics
16. Computers
17. Graphic Science
18. Work Shop
19. Mechanics
20. Fluid Mechanics
21. Material Science
22. Strength of Materials
23. Kinematics
24. Machine design
25. Boiler
26. Steam Engine
27. Internal Combustion Engine
28. Thermodynamics
29. Ships Stability and Buoyancy
30. Heat Transfer
31. Naval Architecture
32. Work Shop Technology
33. Infantry
34. Leadership
35. Naval Instructor
36. Naval Hygiene
37. Material and Financial Management
38. Seamanship
39. Navigation
40. Meteorology
41. Oceanography
42. Naval Operation
43. Communication
44. CIC and Lookout
45. Gunnery
46. Torpedo
47. Mine
48. Antisubmarine Weapons
49. Rocket and Guided Missiles
50. Nuclear Weapons
51. Amphibious Warfare
52. Physical Education

Ranking Form for Professional Criterion

Rank	Number in Rank	Subjects Equal in Rank												Rank
1														1
2														2
3														3
4														4
5														5
6														6
7														7
8														8
9														9
10														10
11														11
12														12
13														13
14														14
15														15
16														16
17														17
18														18
19														19
20														20
21														21
22														22
23														23
24														24
25														25
26														26
27														27
28														28
29														29
30														30
31														31
32														32

Ranking Form for Academic Criterion

Rank	Number in Rank	Subjects Equal in Rank													Rank
1															1
2															2
3															3
4															4
5															5
6															6
7															7
8															8
9															9
10															10
11															11
12															12
13															13
14															14
15															15
16															16
17															17
18															18
19															19
20															20
21															21
22															22
23															23
24															24
25															25
26															26
27															27
28															28
29															29
30															30
31															31
32															32

APPENDIX D

The Ford Procedure

The computation of weights assigned to the Naval Academy subjects from the rank order assigned by the "Judges," utilizes the Ford Computer Program programmed by Pelz and Andrews (1966), adapting L.R. Ford Jr.'s (1957) procedure.

The Ford Program is an ideal tool for this purpose, Arima and Masters (1972) in their validation of the "Ford" Program commented,

> "... There are three characteristics of Ford's procedures that makes it especially appropriate for obtaining judgments on several alternatives or items from diverse group of judges. First a judge rates or adjudicates only those items that he feels competent to judge. Second, he can make his judgments as coarse or as fine as he desires because there is no restrictive on how many judgmental categories he must use. And third, there is no requirement for a fixed distribution of items among the categories except that, collectively over judges no more than one third of all items being rated should be in any one category. A judge, for example, might decide to judge only half of a pool of ..... using three categories -- high, medium, and low.
>
> "... It can be concluded that the Ford Procedure and present program can be used to obtain qualitative judgments with accuracy and efficiency."

The Ford Procedure is based on forming a win-loss matrix, $A = (a_{ij})$, where a_{ij} represents the number of times object i is preferred over object j by the judges, and $a_{ii} = 0$. However, all ties and non-judged items do not enter the matrix for any one judge since a win-loss determination has not been made. Thus, each judge contributes to the composite judgment only those pairwise instances in which he has preferred an alternative over another. The Ford Procedure then determines a weight, w_i, for each item. These weights are interpreted as odds in the sense that the probability of item i being preferred to item j in any comparison is taken to be $w_i/(W_i + w_j)$. These probabilities could then be used to compute matrix A.

The weights are obtained by solving iteratively the equation

$$w_i^{n+1} = \frac{a_{ij}}{\sum_j \frac{a_{ij} + a_{ji}}{w_i^n + w_j^n}}$$

where a_{ij} is the number of times object i was preferred to object j; a_{ji} is the number of time object j was preferred to object i; w_i^n is the weight assigned to object i on the n^{th} iteration; and w_j^n is the weight assigned to object j on the n^{th} iteration. The weights are win percentages on the first iterations. The iteration stops in the computer program when a predetermined convergence criterion is reached or a predetermined number of iterations has been completed. A revision to the Ford Procedure was done by Pelz and Andrews (1966) to remove universally high and universally low items from the win-loss matrix before computing the weights and by adding a very small constant 0.00001 to each remaining entry in the matrix (Arima and Mister 1972).

```
C         A CCMPUTER RANKING PROCEDURE FOR PARTIALLY ORDERED          C
C         DATA. COMPARISCNS MADE IN THREE CORES.                      C
C              INPUT VARIABLE NAMES-                                  C
C               N= # OF CBJECTS BEING RANKED  < CR = TO 1CO           C
C               JJ= # OF JUDGES  < OR = TC 100< CR = TO 100           C
C               EPSLON= CCNVERGENCE CRITERION                         C
C               JUPPER= MAX # OF ITERATICN> DESIRED W/OUT             C
C                       CCNVERGENCE  .                                C
C         THE DATA DECK IS ARRANGED IN THE FOLLCWING MANNER-          C
C            1.LABEL CARD- PUNCH 1 IN CCL 1, FCLLCWED BY 71H          C
C            2.PARAMETER CARD- FORMAT(2I6,F6.3,I6)                    C
C              COL 1-6 = # CF OBJECTS (N)                             C
C              COL 7-12 = # OF JUDGES (JJ)                            C
C              CCL 13-18 = CCNVERGENCE CRITERICN (EPSLON)             C
C              COL 19-24 = MAX # OF ITERATIONS (JUPPER)               C
C            3.JUDGE CARD- FORMAT(I6)                                 C
C              CCL 1-6 = # OF RANKS USED BY THIS JUDGE (NG)           C
C            4.DATA CARDS- FCRMAT(24I3)                               C
C              COL 1-3 = # OF OBJECTS IN THIS RANK                    C
C              CCL 4-72 = ID NUMBER OF CBJECTS IN THIS RANK,          C
C           CCNTINUE ON WITH AS MANY CARDS AS NECESSARY TC            C
C           CCMPLETE A RANK                                           C
C            5.THERE MUST BE (JJ) BLOCKS CF (3) AND (4).              C
C                                                                     C
      INTEGER*2 LIST(100)
      INTEGER*2 LOSS(100)
      DIMENSICN WIN(100)
      DIMENSICN NR(100),NC(100),NTG(100),MC(100,1C0)
      CCMMON LIST
      CCMMON NG,NGM1,IP1,NTGI,NTGJ,NTG,EPSLON,NR,NC,N,NCOUNT,JUPPER,MC
      REAL LOSSES
      INTEGER OUTPUT
      LEN=0
      INPUT=5
      IDISK=9
      OUTPUT=6
      READ(INPUT,1000)
 1000 FORMAT (72H
     X                      )
      WRITE(OUTPUT,1000)
      REWIND 9
      READ(INPUT,1) N,JJ,EPSLCN,JUPPER
    1 FORMAT (2I6,F6.3,I6)
      DO 2 I=1,N
      NR(I)=0
    2 NC(I)=0
      NCOUNT=0
      DO 8 J1=1,JJ
```

```
      NCNT1=NCOUNT
      READ(INPUT,3) NG
    3 FORMAT (I6)
C                                                                      C
C                                                                      C
C          A SEQUENTIAL ID NUMBER IS ASSIGNED TO THE ORIGINAL          C
C          ID NUMBER OF THE OBJECTS BEING JUDGED IN ORDER OF           C
C          THEIR APPEARANCE IN THE DATA, UNTIL ALL OBJECTS             C
C          BEING JUDGED ARE ACCOUNTED FOR. NO DUPLICATION OF           C
C          ASSIGNMENTS IS MADE.                                        C
C                                                                      C
      DO 5 NG1=1,NG
      READ(INPUT,4) NTG1,(MC(NG1,K),K=1,NTG1)
    4 FORMAT (24I3,8X)
      DO 10 I=1,NTG1
      IF(LEN.EQ.0) GO TO 25
      DO 20 J=1,LEN
      IF(MC(NG1,I).EQ.LIST(J)) GO TO 30
   20 CONTINUE
   25 LEN=LEN+1
      LIST(LEN)=MC(NG1,I)
      J=LEN
   30 MC(NG1,I)=J
   10 CONTINUE
    5 NTG(NG1)=NTG1
      NGM1=NG-1
C                                                                      C
C          THE NUMBER OF COMPARISONS WHICH MUST BE MADE BY             C
C          EACH JUDGE IS COMPUTED. NO COMPARISONS ARE MADE             C
C        BETWEEN OBJECTS IN THE SAME RANK.                             C
C                                                                      C
      DO 7 I=1,NGM1
      IP1=I+1
      NTGI=NTG(I)
      DO 7 J=IP1,NG
      NTGJ=NTG(J)
      DO 7 IC=1,NTGI
      DO 7 JC=1,NTGJ
      NN1=MC(I,IC)
      NN2=MC(J,JC)
      IF (NN1-NN2) 6,7,6
    6 WRITE(IDISK) NN1,NN2
      NCOUNT=NCOUNT+1
      NR(NN1)=1
      NC(NN2)=1
    7 CONTINUE
      NCNT1=NCOUNT-NCNT1
    8 WRITE(OUTPUT,9) J1,NCNT1
```

```
    9 FORMAT ( 6HOJUDGE I5, 1C(1H ),I7,12H COMPARISONS )
      END FILE 9
      REWIND 9
      WRITE(OUTPUT,500)
  500 FORMAT(1H0,'ID NUMBER MAP')
      WRITE (OUTPUT,501)
  501 FORMAT(15(1H ),13HASSIGNED ID #,15(1H ),13HORIGINAL ID #/)
      WRITE(OUTPUT,502) (I,LIST(I),I=1,N)
  502 FORMAT(T20,I4,T49,I4)
      CALL CORE2
      CALL CORE3
      STOP
      END
C                                                                       C
C          RANKING PROCEDURE -- CORE 2


      SUBROUTINE CORE2
      INTEGER*2 LIST(100)
      INTEGER*2 LOSS(100)
      DIMENSION WIN(100)
      DIMENSION NR(100),NC(100),A(100,100),W(100),X(100),MAN(100)
      COMMON LIST
      COMMON M1,M2,INEW,JNEW,IP1,W,EPSLON,NR,NC,N,NCOUNT,JUPPER,A,X,MAN
      REAL LOSSES
      INTEGER OUTPUT
      INPUT=5
      OUTPUT=6
      IDISK=9
      DO 1 I=1,N
      DO1 J=1,N
    1 A(I,J)=0.0
C                                                                       C
C          TABULATES FOR EACH COMPARISON THE NUMBER OF TIMES            C
C          THAT COMPARISON IS MADE BY ALL JUDGES IN THE                 C
C          EXPERIMENT. THIS TABULATION IS DONE FROM RANKING             C
C          ORDER AND IS THE NUMBER OF TIMES OBJECT I WAS                C
C          PREFERRED TO OBJECT J,IE,THE WIN-LOSS MATRIX.                C
C                                                                       C
      DO 2 NCNT1=1,NCOUNT
      READ(IDISK) M1,M2
    2 A(M1,M2)=A(M1,M2)+1
      ITER=0
      DO 34 I=1,N
   34 MAN(I)=I
      WRITE(OUTPUT,300)
      DO  88 I=1,N
   88 WRITE(OUTPUT,36)(A(I,J),J=1,N)
```

```
      DO 666 I=1,N
      WINS=0.0
      DO 667 J=1,N
      WINS=WINS+A(I,J)
  667 CONTINUE
      WIN(I)=WINS
      WRITE(OUTPUT,661) I, WINS
  666 CONTINUE
      DO 771 J=1,N
      LOSSES=0.0
      DO 772 I=1,N
      LOSSES=LOSSES+A(I,J)
  772 CONTINUE
      LOSS(J)=LOSSES
      WRITE(OUTPUT,662) J,LOSSES
  771 CONTINUE
      DO 888 I=1,N
      TOTAL=WIN(I)+LOSS(I)
      PERCNT=WIN(I)/TOTAL
      WRITE(OUTPUT,660) I,PERCNT
      WRITE(7,663) LIST(I),PERCNT
  660 FORMAT(10X,'ROW ',I4,' WIN PERCENT WAS ',F6.5)
  661 FORMAT(10X,'ROW ',I4,' HAD ',F8.2,' WINS. ')
  662 FORMAT(10X,'COLUMN ',I4,' HAD ',F8.2,' LOSSES.')
  663 FORMAT(10X,'NUMBER ',I4,' WIN PERCENT WAS ',F6.5)
  668 FORMAT(10X,I4,10X,F8.2)
 9998 FORMAT(   F6.5,10X,I4)
 9999 FORMAT(   F8.2,10X,I4)
  888 CONTINUE
C                                                                  C
C           OBJECTS WHICH ARE RATED UNIVERSALLY HIGH OR            C
C           UNIVERSALLY LOW ARE REMOVED FROM THE COMPUTATIONS.     C
C           THE APPROPRIATE ROWS AND COLUMNS OF THE WIN-LOSS       C
C           MATRIX ARE ALSO REMOVED.                               C
C                                                                  C
   33 DO 3 I=1,N
      IF (NR(I)*NC(I)) 3,4,3
    3 CONTINUE
      GO TO 100
    4 INEW=0
      WRITE(OUTPUT,300)
  300 FORMAT(1H0,'WIN-LOSS MATRIX ORDER D BY ASSIGNED ID NUMBER')
      DO 70 I=1,N
   70 WRITE(OUTPUT,36) (A(I,J),J=1,N)
   36 FORMAT(30F4.0)
      ITER=ITER+1
      DO 10 I=1,N
      IF(NR(I)*NC(I)) 9,18,9
```

```
    9 INEW=INEW+1
      JNEW=1
      MAN(INEW)=MAN(I)
      DO 1000 J=1,N
      IF (NR(J)*NC(J)) 11,1000,11
   11 A(INEW,JNEW)=A(I,J)
      JNEW=JNEW+1
 1000 CONTINUE
   10 CONTINUE
      N=INEW
      DO 31 I=1,N
      NR(I)=0
   31 NC(I)=0
      DO 30 I=1,N
      DO 30 J=1,N
      IF (A(I,J)) 32,30,32
   32 NR(I)=1
      NC(J)=1
   30 CONTINUE
      GO TO 33
C                                                                         C
C                                                                         C
C          COMPUTES THE INITIAL WEIGHTING FACTORS OF THE                 C
C          OBJECTS FROM THE WIN-LOSS MAT-IX. THESE WEIGHTING             C
C          FACTORS ARE THE PROBABILITY THAT OBJECT I IS
C          PREFERRED TO OBJECT J.                                        C
C                                                                         C
  100 DO 16 I=1,N
      W(I)=0.0
      DO 13 J=1,N
   13 W(I)=W(I)+A(I,J)
      Z=0.0
      DO 15 J=1,N
   15 Z=Z+A(J,I)
   16 X(I)=W(I)/(W(I)+Z)
      DO 200 I=1,N
      DO 200 J=1,N
  200 A(I,J)=A(I,J)+ .00001
C                                                                         C
C          COMPUTES THE NUMBER OF TIMES OBJECT I AND OBJECT J            C
C          ARE RANKED RELATIVE TO EACH OTHER.                            C
C                                                                         C
      DO 14 I=1,N
      IP1=I+1
      DO 14 J=IP1,N
      A(I,J)=A(I,J)+A(J,I)
   14 A(J,I)=A(I,J)
      REWIND 9
```

```
      RETURN
   18 IF (NR(I)) 8,5,8
    8 WRITE(OUTPUT,12) MAN(I),ITER
   12 FORMAT(1H0,22HSUBJECT ASSIGNED ID #,I3,35H IS UNIVERSALLY RATED HI
     XGH,DELETED,I3, 3H RY )
      GO TO 10
    5 WRITE(OUTPUT,7) MAN(I),ITER
    7 FORMAT(1H0,22HSUBJECT ASSIGNED ID #,I3,35H IS UNIVERSALLY RATED LO
     XW ,DELETED,I3, 3H RY )
      GO TO 10
      END
C                                                                     C
C         RANKING PROCEDURE -- CORE3                                  C
C                                                                     C

      SUBROUTINE CORE3
      INTEGER*2 LIST(100)
      INTEGER*2 LOSS(100)
      REAL*8 NAME
      DIMENSION WIN(100)
      DIMENSION NR(100),NC(100),A(100,100),W(100),X(100),MAN(100),
     1 Y(100),Q(100)
      DIMENSION R(100),Z(100),KEY(60)
      COMMON LIST
      COMMON JC,KO,DENOM,XA,XG,W,EPSLON,NR,NC,N,NCOUNT,JUPPER,A,X,MAN
      REAL LOSSES
      INTEGER OUTPUT
      INPUT=5
      OUTPUT=6
      IDISK=9
      JC=0
      READ(5,99) NAME
99    FORMAT(A8)
      DO 100 I=1,N
100   R(I)=LIST(I)
      CALL SHSORT(R,KEY,52)
    8 KC=0
C                                                                     C
C         COMPUTES NEW WEIGHTING FACTOR FOR OBJECT I FOR              C
C         ITERATION BEING CONSIDERED.                                 C
C                                                                     C
      DO 3 I=1,N
      DENOM=0
      DO 4 J=1,N
    4 DENOM=DENOM+A(I,J)/(X(I)+X(J))
    3 Y(I)=W(I)/DENOM
      JC=JC+1
```

```
C                                                                         C
C        CONVERGENCE CRITERICN CHECH.                                     C
C                                                                         C
    5 DC 9 I=1,N
      IF(ABS(Y(I)-X(I))/X(I)-EPSLCN) 9,9,10
   1C KC=KO+1
    9 X(I)=Y(I)
      WRITE(OUTPUT,12) JC,KC,(Y(I),I=1,N)
   12 FCRMAT (1HO,I5,I10/(6F18.6))
      IF(KO)  17,17,13
C                                                                         C
C        ITERATION COUNT CHECK.                                           C
C                                                                         C
   13 IF (JO-JUPPER) 8,14,14
   14 WRITE(OUTPUT,15) JUPPER
   15 FCRMAT(1HO,I5,46H ITERATIONS, NO CONVERGENCE. DATA SET DELETED. )
   17 WRITE(OUTPUT,18) (MAN(I),LIST(MAN(I)),Y(I),I=1,N)
      WRITE(7,664)(LIST(MAN(I)),Y(I),I=1,N)
      DC 200 I=1,N
200   Z(I)=Y(KEY(I))
      CALL SHSORT(Z,KEY,52)
      J=53
      DC 400 I=1,N
      J=J-1
      WRITE(6,500) KEY(I),J,Z(KEY(I)),JC,NAME
      WRITE(7,501) KEY(I),J,Z(KEY(I)),JC,NAME
400   CONTINUE
500   FCRMAT(' ',T20,I2,T35,I2,T48,F9.6,T65,I2,T73,A8)
501   FCRMAT(T20,I2,T35,I2,T48,F9.6,T65,I2,T73,A8)
   18 FCRMAT (14H1FINAL WEIGHTS//15(1H ),
     X13HASSIGNED ID #, 3(1H ),13HORIGINAL ID #,12(1H ),6HWEIGHT//(1HO,
     X2I19,F24.6))
  664 FCRMAT(10X,'NUMBER ',I4,' WEIGHT IS ',F24.6)
      RETURN
      END
```

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Two hundred and fifty Thai Naval officers were surveyed to determine the appropriateness of the Thai Naval Academy curriculum. Seventy-seven responded. They were asked to rank the importance of subjects in the curriculum for two criteria: the naval profession, and intellectual development of the individual. The rankings were scaled using the "Ford Computer Program." A judge reliability check done by correlating the rankings of half the judges against the other half showed a high positive correlation (r = .908), indicating uniformity of

of judgements. The scaled "weights" of both criteria were then reduced to one dimension by orthogonal projection onto a straight line contained in the plane with the two criteria as their axes. The resulting "weights" were used as the criterion variable and compared with percent of instruction time per subject in the curriculum. The correlation coefficient (rho) between the ranks of the weights and the ranks of the instruction time was low (rho = .423), but significant. The difference in ranks were used as indicator of each subject's level of appropriateness. Many subjects were found to be inappropriate. Adjustments of instruction time or replacement of those subjects highly inappropriate was deemed advisable.

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